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AXEL: high-pressure Xe gas TPC for neutrinoless double beta decay search

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A Xenon ElectroLuminescence (AXEL) experiment aims to search for neutrinoless double beta decay ($0\nu\beta\beta$) using a high-pressure xenon gas time projection chamber. We have developed a novel ionization-electron counter called Electroluminescence Light Collection Cell (ELCC), which enables to achieve excellent scalability and background rejection with track patterns and superior energy resolution. Performance of the detector has been demonstrated using a 180L-size prototype. A dedicated Cockcroft-Walton high-voltage generator was installed inside the chamber and successfully applied up to −34.3 kV in 6.8 bar of xenon gas. The obtained energy spectrum exhibited numerous sharp peaks, achieving an energy resolution of (0.67±0.08) % FWHM at 2615 keV. Furthermore, three-dimensional electron tracks were successfully reconstructed, and evaluation of background rejection with machine-learning based technique is ongoing using the obtained tracks. To improve track clarity, the Richardson-Lucy deconvolution method is under development. Toward the first $0\nu\beta\beta$ search with the AXEL detector, a 1000L-size detector is in construction, and R&D efforts are underway on several key components, including high-voltage generation up to −76.4 kV using the Cockcroft-Walton generator, large-area silicon photomultiplier for the ELCC, low-radioactivity connector for signal transfer, dedicated readout electronics, and efficient scintillation light detector.

Collaboration you are representing

AXEL experiment

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